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Dated 7 June 2004

Patents Form 1/77

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(Rule 1)

- 4 APR 2003

04APR03 E797960-1 D01055
P01/7700 0.00-0307808.6

Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office

- 4 APR 2003

Cardiff Road
Newport
Gwent NP9 1RH

1. Your reference
   03-RRI-908

2. Patent application number
   (The Patent Office will fill in this part)
   0307808.6

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*
   Eaton Corporation
   1111 Superior Avenue
   Eaton Centre
   Cleveland, Ohio 44114-2584
   USA

   Patents ADP number *(if you know it)*
   6715122001

   If the applicant is a corporate body, give the country/state of its incorporation
   Cleveland, OHio, USA

4. Title of the invention
   Hydraulic System

5. Name of your agent *(if you have one)*
   Geoffrey Clarke
   c/o Derek Parnaby
   Eaton Limited
   P O Box 22 Regd. Offices
   Norfolk Street
   Worsley, Manchester
   M28 3 ET

   "Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

   Patents ADP number *(if you know it)*
   7716442002

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*
   a) any applicant named in part 3 is not an inventor, or
   b) there is an inventor who is not named as an applicant, or
   c) any named applicant is a corporate body.
   See note (d))

Patents Form 1/77

9 Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form	
Description	7
Claim(s)	-
Abstract	-
Drawing(s)	2 + 2 R/-

10. If you are also filing any of the following, state how many against each item.

Priority documents	n/a
Translations of priority documents	n/a
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	no
Request for preliminary examination and search *(Patents Form 9/77)*	no
Request for substantive examination *(Patents Form 10/77)*	no
Any other documents *(please specify)*	Cover Letter

11. I/We request the grant of a patent on the basis of this application.

Signature Geoffrey Clarke Date 3 April 03.

12. Name and daytime telephone number of person to contact in the United Kingdom Geoffrey Clarke 07802 2500 83

Warning

After an application for a patent has been filed, the Comptroller of the Patent Office will consider whether publication or communication of the invention should be prohibited or restricted under Section 22 of the Patents Act 1977. You will be informed if it is necessary to prohibit or restrict your invention in this way. Furthermore, if you live in the United Kingdom, Section 23 of the Patents Act 1977 stops you from applying for a patent abroad without first getting written permission from the Patent Office unless an application has been filed at least 6 weeks beforehand in the United Kingdom for a patent for the same invention and either no direction prohibiting publication or communication has been given, or any such direction has been revoked.

Notes

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b) *Write your answers in capital letters using black ink or you may type them.*

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d) *If you have answered 'Yes' Patents Form 7/77 will need to be filed.*

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Hydraulic System

This invention relates to means of reducing noise and pressure pulsations in hydraulic circuits.

Noise in hydraulic systems is initiated by the generation of a fluid wave. This may take the form of a single pulse or series of pulses. When the pulse meets impedance in the circuit pressure is generated, which may be reflected in the circuit. This force may then enter the mechanical structure of the circuit resulting in vibration and audible noise. A common example of this phenomenon is water hammer.

Various means are known to reduce noise and pulsation dampings in hydraulic circuits. The circuits can be tuned by use various resonators and actuators, such systems are generally known in the art. The location of the attenuators can be varied according to the particular application. Clearly, it is important to ensure that any attenuator does not adversely affect the performance of the hydraulic system.

A flexible hose can be used to resolve various noise problems in fluid and gas circuits. Typical examples of this are 'grunt' and 'rack rattle' in hydraulic power steering circuits, where noise in the fluid can be generated from instability in the steering gear (valve) or from forced road input from the steering track rods.

Various forms of flexible elastic hose are known to be incorporated in hydraulic systems. These are frequently necessary to connect between components which may have a relatively large degree of movement between them. Examples of this are mountings from a vehicle body to the engine, or situations in which components are connected across articulated portions of the vehicle. Conventional hose used in these applications is of a braided construction and circular cross section. Normally the hose will respond to pulsations and pressure peaks generated in the system by expanding the walls of the hose. A particular disadvantage of the use of the conventional circular hose is that the expansion results in a stretching of the side wall or the

braiding. Therefore, the hose has to be designed to accommodate the level of pressure variation which is going to be normally experienced in the system and additionally be provided with a substantial safety margin to ensure it does not burst under the highest pressures experienced in the system.

One solution to the current problem is to provide a flat of elliptical-shaped cross-section hose.

An example of one such hose consists of a flexible hose material, such as rubber, of braided construction and that is oval or flat in section. The hose is positioned as close to the source of the noise as possible. In the case of a power steering system the hose is typically positioned in the low-pressure side of the system close to the steering rack. An example of such a hose is called Platypus hose.

The purpose of the Platypus hose is to absorb at least some of the hydraulic fluid pulses that are generated and minimize the creation of pressure pulses and reflections in the circuit. This is achieved by the oval, or flat section in the hose. When a hydraulic pulse is generated the oval/flat section is able to change readily in section to become less oval and more round. This enables the hose to increase in volume without the wall of the hose becoming stressed, as with a round section hose. This ability to increase in volume relatively easily enables the pulse to be damped, which in consequence generates minimal vibration and noise.

The invention will now be described in greater detail with respect to the attached figures, in which

Figure 1 shows the general arrangement of a system using a platypus type of hose.

Figure 2 shows a known round section hose

Figure 3 shows an elliptical section hose

Figure 4 shows a flat section platypus hose.

Figure 1 shows a steering rack amounting in a vehicle. The steering rack is of the type which is generally called power assisted steering, in which hydraulic fluid under pressure is used to reduce the steering effort for the driver. The system comprises a reservoir for storing a volume of fluid, a suction hose leading from the reservoir to a pump. The pump is normally driven by the prime mover of the vehicle (the petrol or diesel motor) but could easily driven by an electric motor. Output from the pump is taken by high-pressure hose to a valve controlling the flow of the hydraulic fluid and which is normally controlled by the steering wheel, the valve being normally mounted on the steering rack. The steering gear valve controls the flow of fluid into the steering rack or hydraulic actuator. The return flow from the steering valve or actuator passes at low pressure through a length of the platypus hose and returns to the reservoir.

Most of the pulsations and high-pressure peaks are generated by the pump and are caused by the pump. Some noise and "grunt" is caused by the actuation of the steering valve itself. Some residual noise and pressure pulsation may pass from the steering valve through the low pressure line to the reservoir. The platypus hose is capable of absorbing these hydraulic fluid pulses minimizing the pressure waves in the return part of the circuit. This helps to reduce the noise and vibration of the overall system.

Figure 2 shows a hose of known type having circular cross-section hose wall 20 with braided construction.

Figure 3 shows an elliptical section hose which can be used to minimize pulsations and pressure peaks. It will be clear that the section of the wall 30 can be changed from elliptical through to circular by variations of pressure in the hose without causing the walls to stretch.

Figure 4 shows a platypus hose, so named because of its similarity in shape to the mouth of the animal of the same name. In this hose the construction of the walls can be of same type of braided construction as the known hoses. The walls 40 are flexible and when not under pressure have the flat section shown. End portions 43 provide small passageways through which fluid can flow under minimum pressure. Since the walls are of flexible construction they can be extended easily to absorb and

hence, damp out pressure pulses.

Whilst it is clear that it would also be possible to incorporate the platypus hose in the high-pressure feed side of the hydraulic circuit, interposed between the pump and steering actuator valve, this could degrade the performance of the circuit and special provision would need to made to ensure that the flexibility of the hose did not dissipate the high-pressure to the extent of the operation of the circuit was compromised or did not meet the performance requirements.

It is clear that platypus type hose can be incorporated in a hydraulic circuit without a reservoir, a so-called reservoirless system.

This description has primarily used a hydraulic power steering circuit to illustrate the application of the Platypus hose, but the same principal could be applied to many other types of hydraulic circuit. This technique could also be applied to other applications, such as those containing gas, rather than fluid.

03 BRI 908

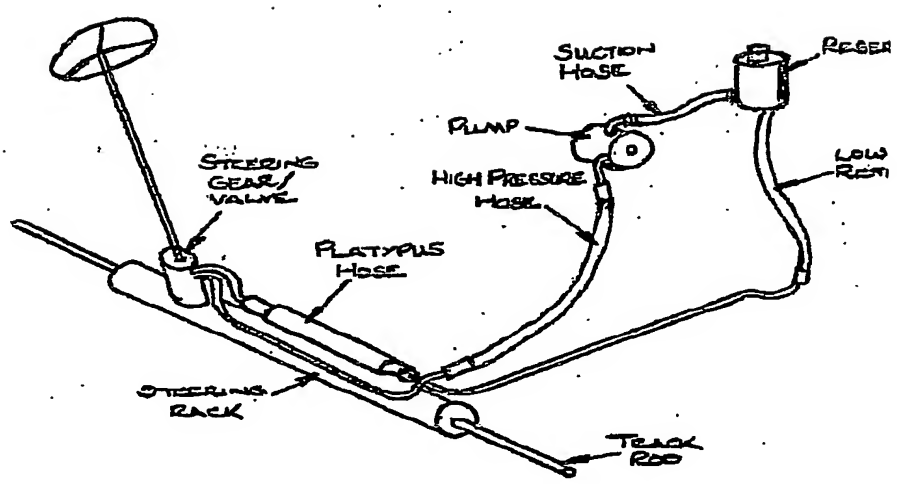

Fig 1

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Fig. 3

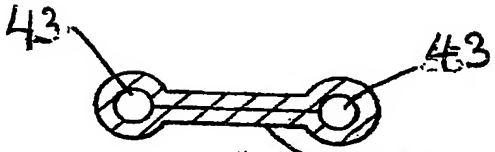


Fig. 4

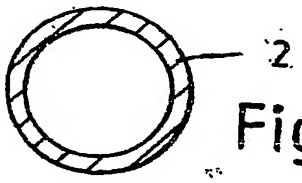
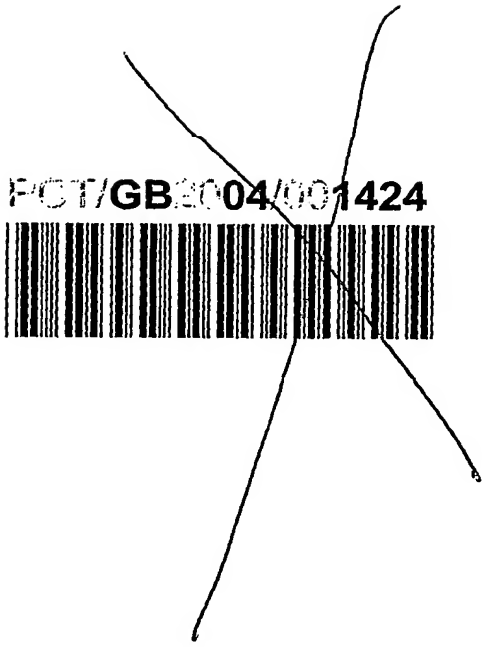


Fig. 2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